

A satellite map of a forested area with a large fire. A thick, white plume of smoke rises from the center of the fire, drifting towards the upper left. Numerous small, red, irregular shapes are scattered across the map, representing fire hotspots. The background is a detailed satellite image of the terrain, showing green forest and brownish ground.

Fire and Smoke Detection Products

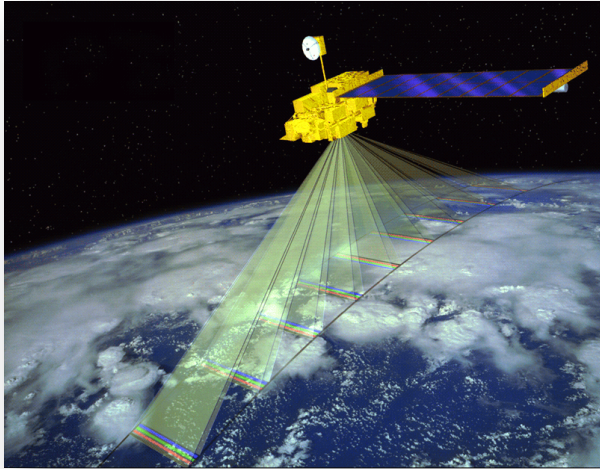
NASA Air Quality Remote Sensing Training
NASA ARSET

Cindy Schmidt, BAERI/NASA Ames
Amber Kuss, BAERI/NASA Ames

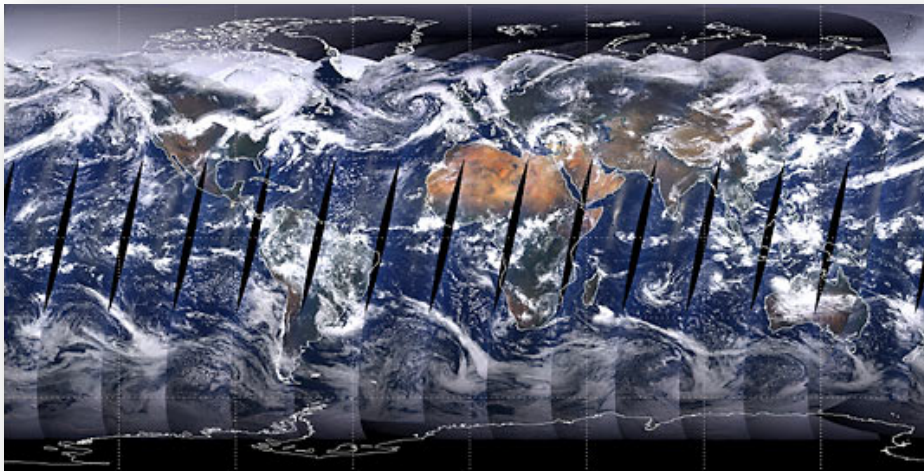
Overview

- ❑ Satellite/Sensor Overview
- ❑ NOAA Fire and Smoke Products
 - ❑ Automated Biomass Burning Algorithm (ABBA)
 - ❑ Fire Id, Mapping and Monitoring Algorithm (FIMMA)
 - ❑ Hazard Mapping System (HMS)
 - ❑ Fire Product Archive
 - ❑ GOES Aerosol Smoke Products (GASP)
 - ❑ GOES Biomass Burning Emissions Product (GBBEP)
- ❑ NASA Fire and Smoke Products
 - ❑ MODIS
 - ❑ VIIRS
- ❑ US Forest Service Fire Products
- ❑ Live Demo: Fire Information for Resource Management System (FIRMS):
Web Fire Mapper
- ❑ Live Demo: Visualizing fire and smoke plumes in Worldview

MODIS (Moderate Resolution Imaging Spectroradiometer)



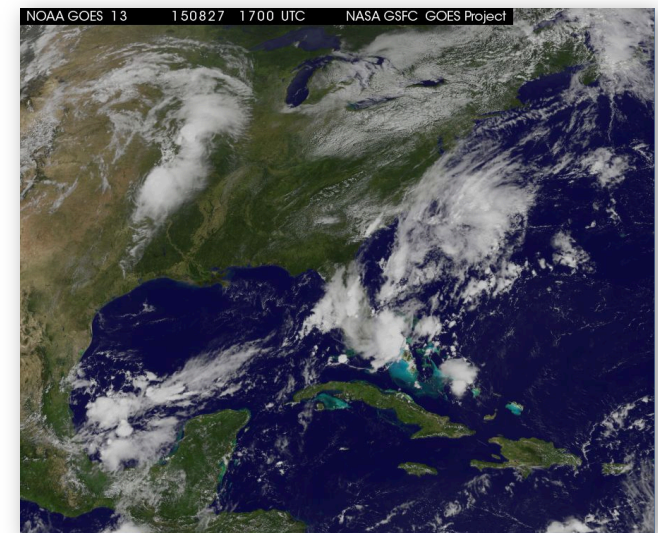
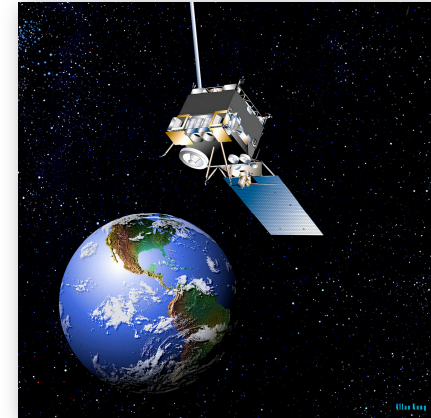
- ❑ Spatial Resolution
 - ❑ 250m, 500m, 1km
- ❑ Temporal Resolution
 - ❑ Daily, 8-day, 16-day, monthly, quarterly, yearly
 - ❑ 2000-present
- ❑ Data Format
 - ❑ Hierarchical data format – Earth Observing System Format (HDF-EOS)



- ❑ Spectral Coverage
 - ❑ 36 bands (major bands include Red, Blue, IR, NIR, MIR)
 - ❑ Bands 1-2: 250m
 - ❑ Bands 3-7: 500m
 - ❑ Bands 8-36: 1000m

GOES (Geostationary Operational Environmental Satellites)

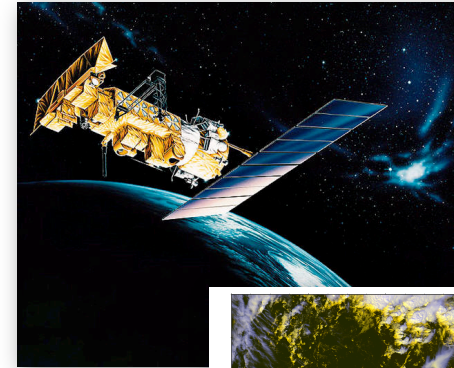
- ❑ Operated by the National Oceanic and Atmospheric Administration (NOAA)
- ❑ Provides data on atmospheric conditions and solar activity
- ❑ Geostationary: Fixed position in the sky
- ❑ Operates from 2 primary locations
 - ❑ GOES East (75° W) for US
 - ❑ GOES West (135° W)
- ❑ Infrared and visible data
- ❑ Resolution:
 - ❑ Spatial: 1km to 16 km (depending on channel)
 - ❑ Every 15 minutes



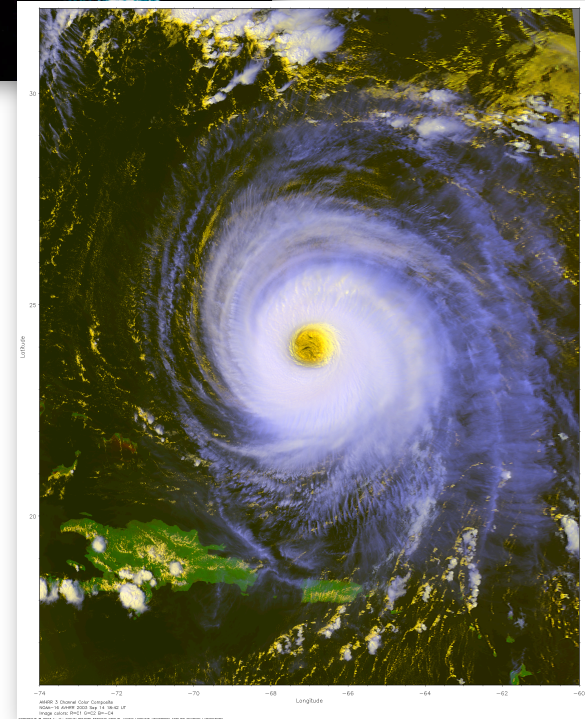
Recent GOES East USA Image

AVHRR (Advanced Very High Resolution Radiometer)

- ❑ Operated by the National Oceanic and Atmospheric Administration (NOAA)
- ❑ Sensor carried on Polar-Operating Environmental Satellites (POES)
- ❑ Infrared and visible data
- ❑ Uses:
 - ❑ Radiance data for clouds
 - ❑ Land-water boundaries
 - ❑ Snow and ice extent
 - ❑ Surface temperature
- ❑ Resolution:
 - ❑ Spatial: 1 km
 - ❑ Temporal: Global coverage twice per day



AVHRR
Image of
Hurricane
Isabel 2003

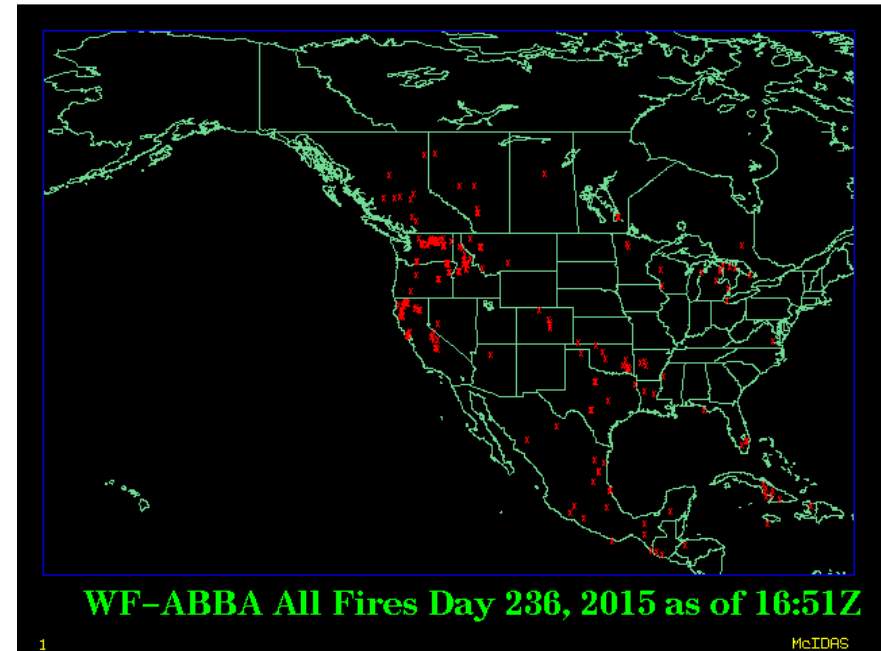


An aerial photograph of a mountainous landscape, likely in the western United States, showing a large wildfire. Numerous red dots are scattered across the terrain, indicating the locations of active fires. Several thick, white smoke plumes are visible, rising from the fire locations and drifting across the sky. The terrain is a mix of brown, tan, and green, representing different vegetation and soil types. The text "NOAA FIRE AND SMOKE PRODUCTS" is overlaid in the center of the image.

NOAA FIRE AND SMOKE PRODUCTS

NOAA: Wildfire Automated Biomass Burning Algorithm (WF-ABBA)

- ❑ Developed in collaboration with the Cooperative Institute for Meteorological Studies (CIMSS), University of Wisconsin
- ❑ Uses the **GOES Imager** to detect and monitor fires throughout the Western Hemisphere
- ❑ Product is run half-hourly
- ❑ Minimum detectable fire size: .5 to 1 acre
- ❑ Data are available for download: ASCII, GIS and graphic formats
- ❑ *This product has NOT been quality controlled*



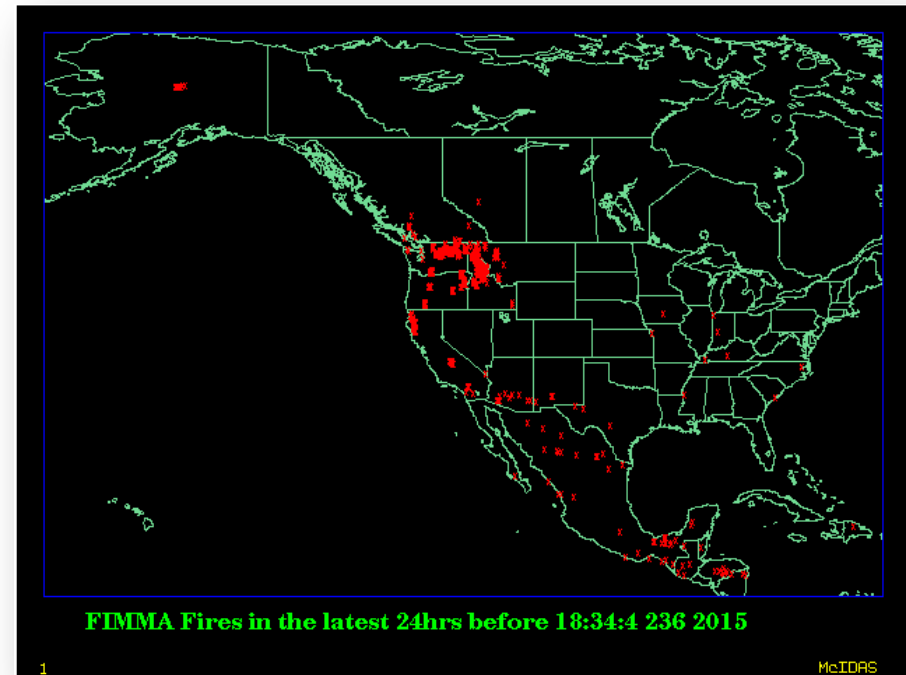
The red "X's" indicate hot spots

Fire locations represent the approximate location of the fire pixel, not the actual fire size.

<http://www.ssd.noaa.gov/PS/FIRE/Layers/ABBA/abba.html>

Fire Id, Mapping and Monitoring Algorithm (FIMMA)

- ❑ Detects fires from **AVHRR**
- ❑ Data are available near-real time, approximately 3-6 hours after satellite overpass
- ❑ This algorithm is only accurate over forested regions
- ❑ Data are available for download in ASCII, GIS and graphic formats
- ❑ *This product has NOT been quality controlled*



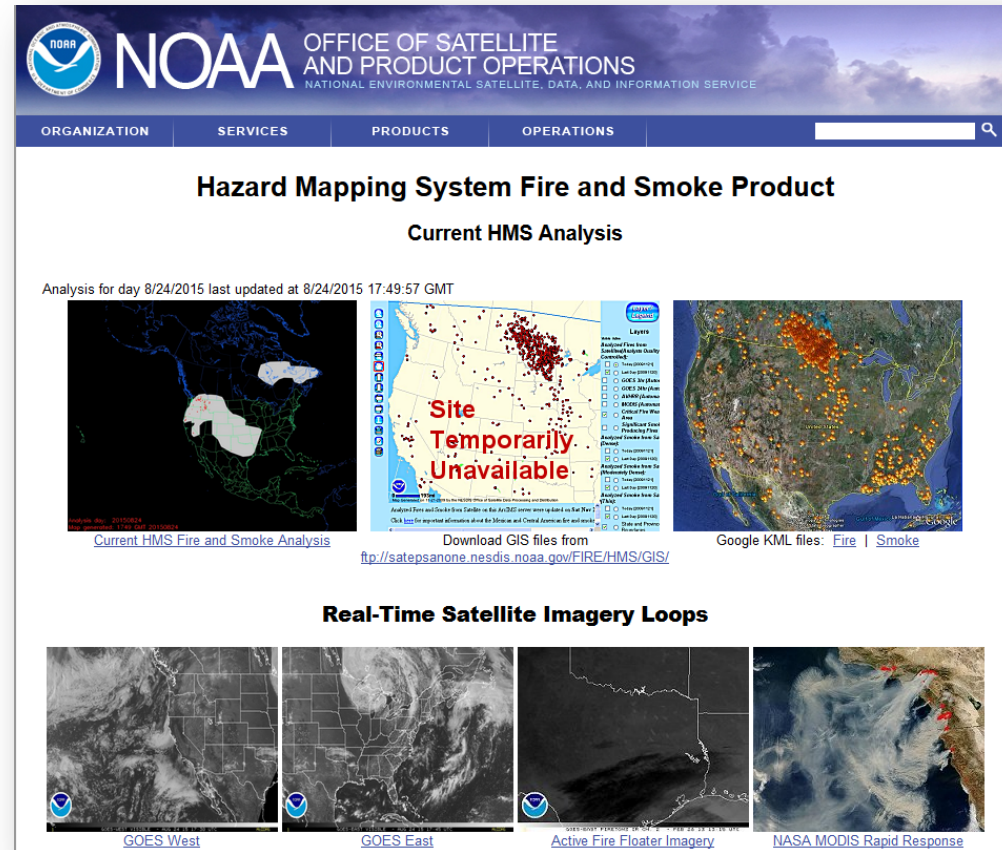
The red "X's" indicate hot spots

Fire locations represent the approximate location of the fire pixel, not the actual fire size.

<http://www.ssd.noaa.gov/PS/FIRE/Layers/FIMMA/fimma.html>

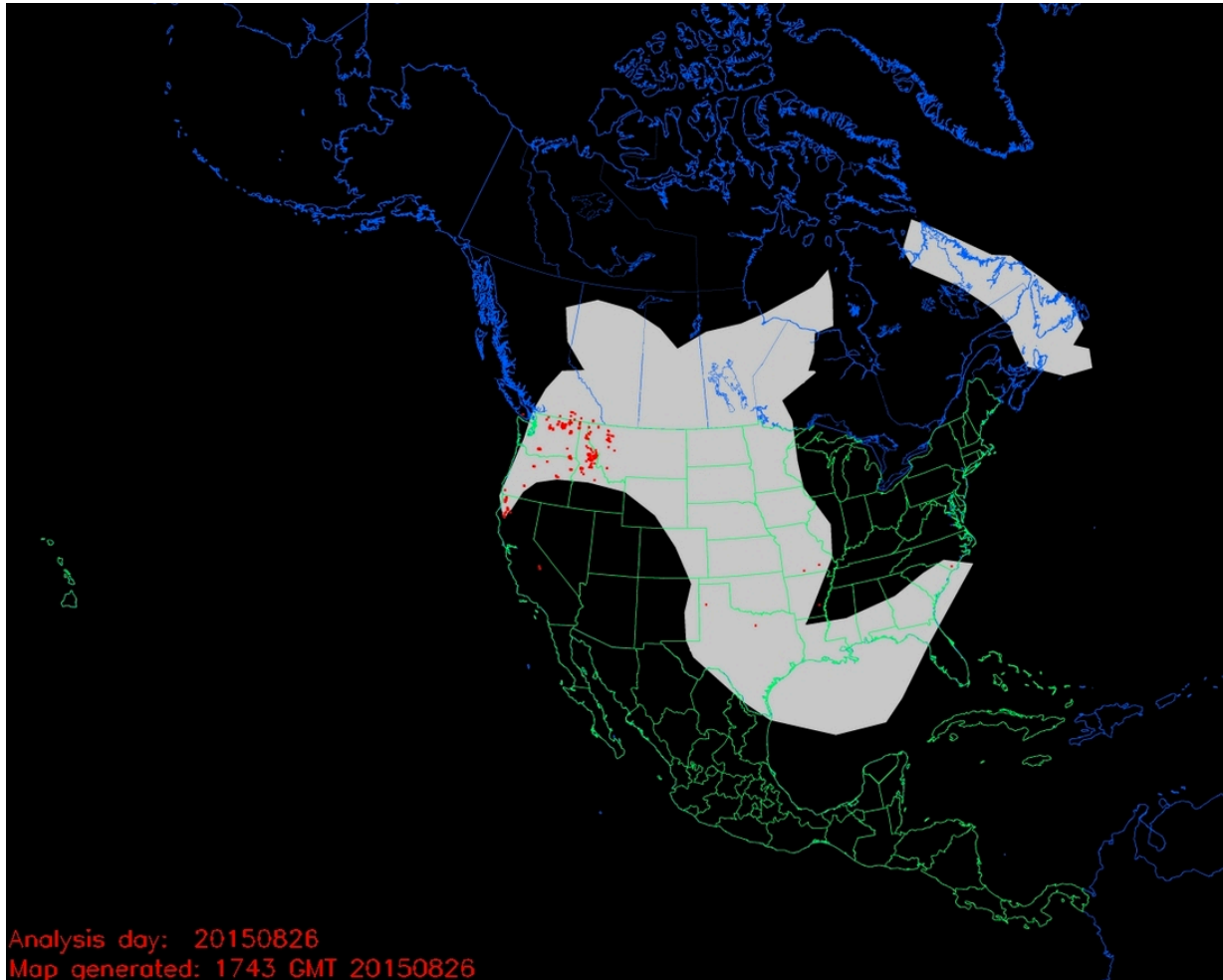
NOAA Hazard Mapping System Fire and Smoke Product (HMS)

- ❑ Shows detected hot spots, smoke plumes and estimated smoke concentrations
- ❑ Blended product from GOES, POES AVHRR and MODIS
- ❑ Spatial resolution: 4km
- ❑ Product provided once daily



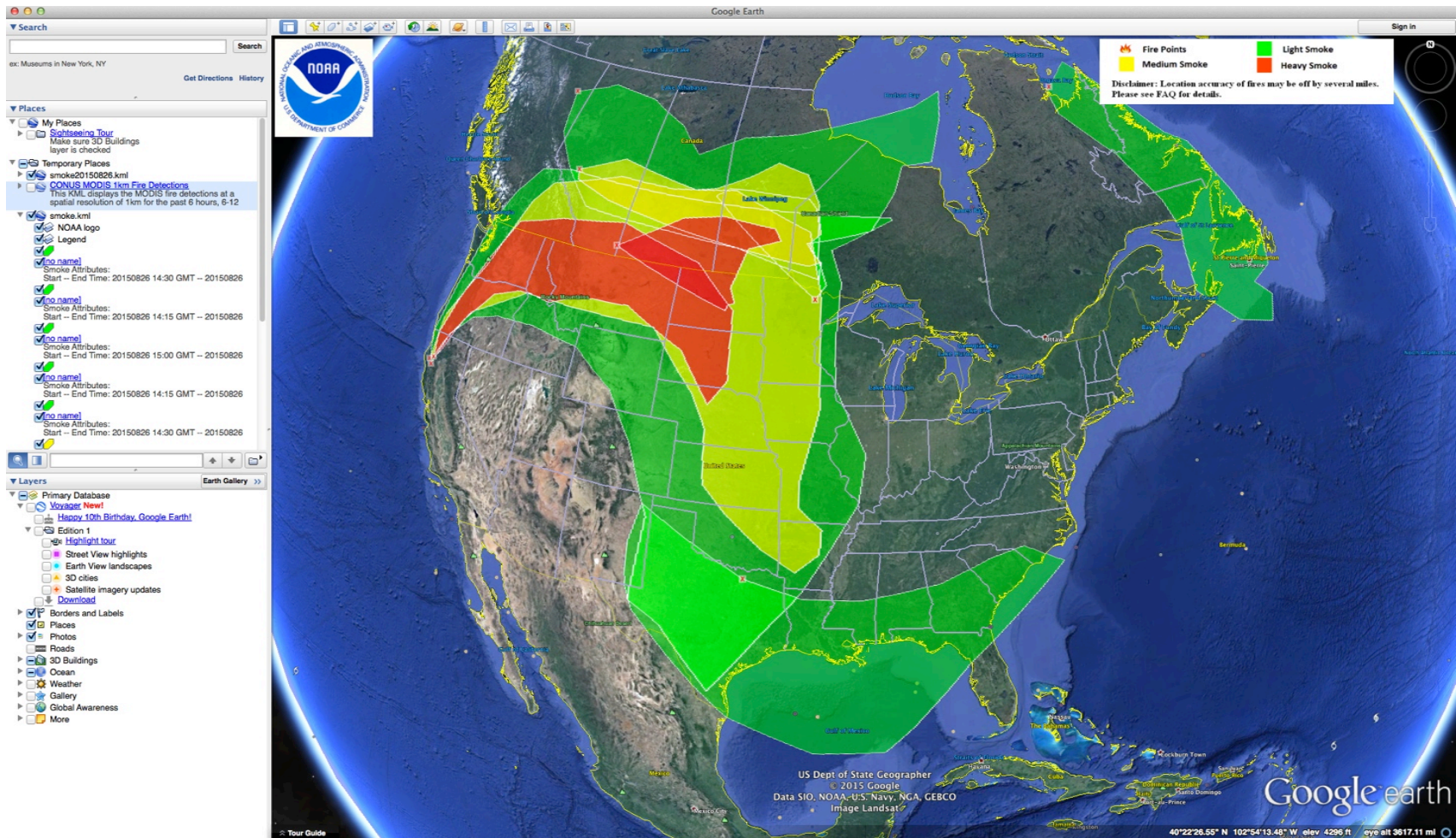
<http://www.ospo.noaa.gov/Products/land/hms.html>

Example: Current HMS Fire and Smoke Analysis



Analysis for 8/26/2015

Example: NOAA HMS Fires and Smoke in Google Earth



Analysis for 8/26/2015

NOAA Fire Web-GIS


WEBSITE DOWN: May need to
remove if still not working

NOAA Fire Product Archive

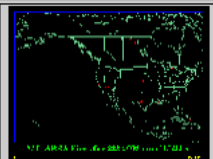
- ❑ Archive of fire products for up to 90 days
- ❑ Products include ABBA, FIMMA, HMS and MODIS
- ❑ Available in various formats: graphic, text, GIS and KML

Fire Products Archive

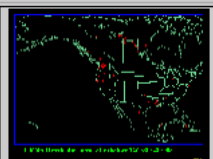
Select the following options to view or download products:




HMS



ABBA-GOES



FIMMA-AVHRR



MODIS

WHAT FIRE PRODUCT?

NONE ▾

WHAT FORMAT?

NONE ▾

TIME PERIOD?

Current Day
Last 2 Days
Last 7 Days
Longer Term Archive

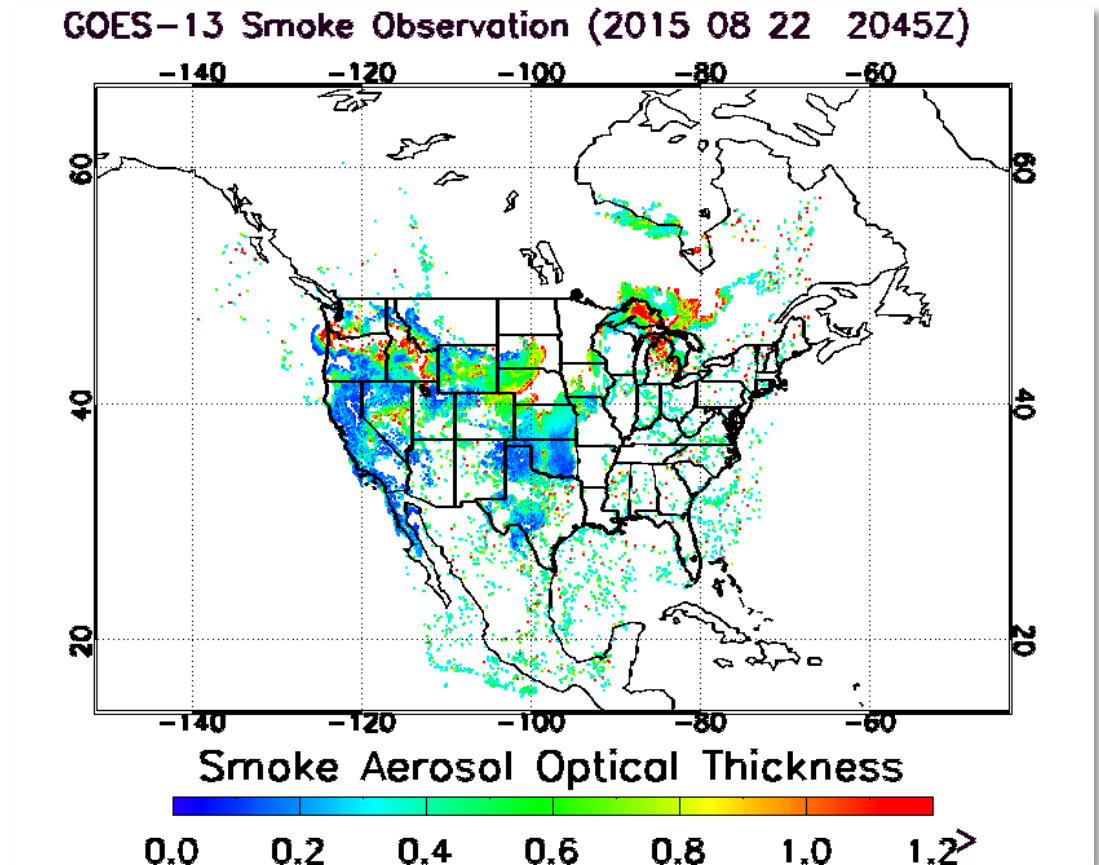
SUBMIT

RESET

<http://satepsanone.nesdis.noaa.gov/FIRE/fire.html>

GOES Aerosol Smoke Products (GASP)

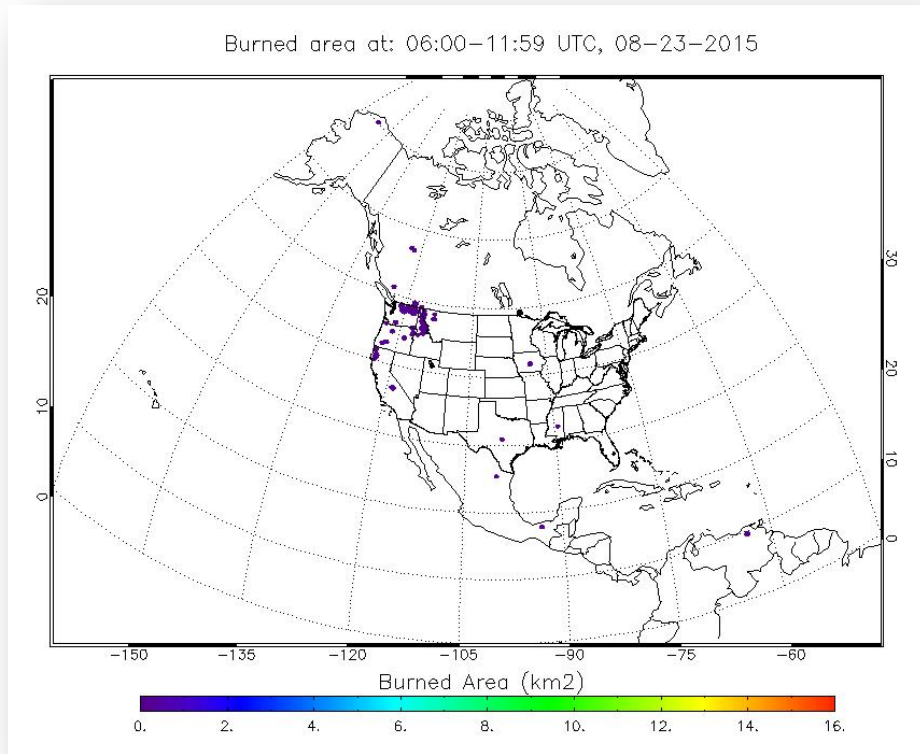
- ❑ Provides aerosol optical depth (AOD) using GOES imagery
- ❑ Available at 30 minute intervals



<http://www.ssd.noaa.gov/PS/FIRE/ASDTA/asda.html>

GOES Biomass Burning Emissions Product (GBBEP)

- ❑ Calculates emissions (PM2.5, CO, CH4, CO2, TNMHC, NH3, N2O, NOX, and SO2) released from biomass burning fire detections using WF-ABBA as the input
- ❑ Product available daily
- ❑ Data available in ASCII format



Emissions available in ASCII format for each point on the map

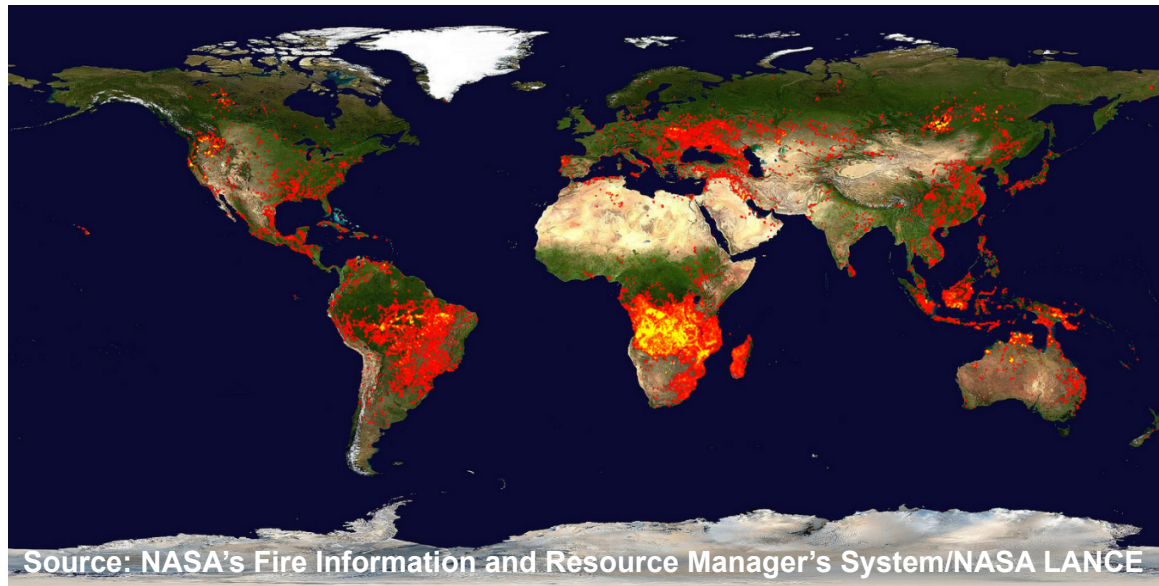
<http://satepsanone.nesdis.noaa.gov/pub/FIRE/BBEP-geo/>

An aerial photograph of a large forest fire. Multiple thick, white smoke plumes rise from the ground, drifting towards the right side of the frame. Numerous small red dots are scattered across the landscape, indicating the locations of active fires. The terrain is a mix of brown, tan, and green, representing different types of vegetation and possibly burned areas. The text "NASA FIRE AND SMOKE PRODUCTS" is overlaid in the center of the image.

NASA FIRE AND SMOKE PRODUCTS

MODIS Fire Products: Near Real-Time Thermal Anomalies/Fire Locations

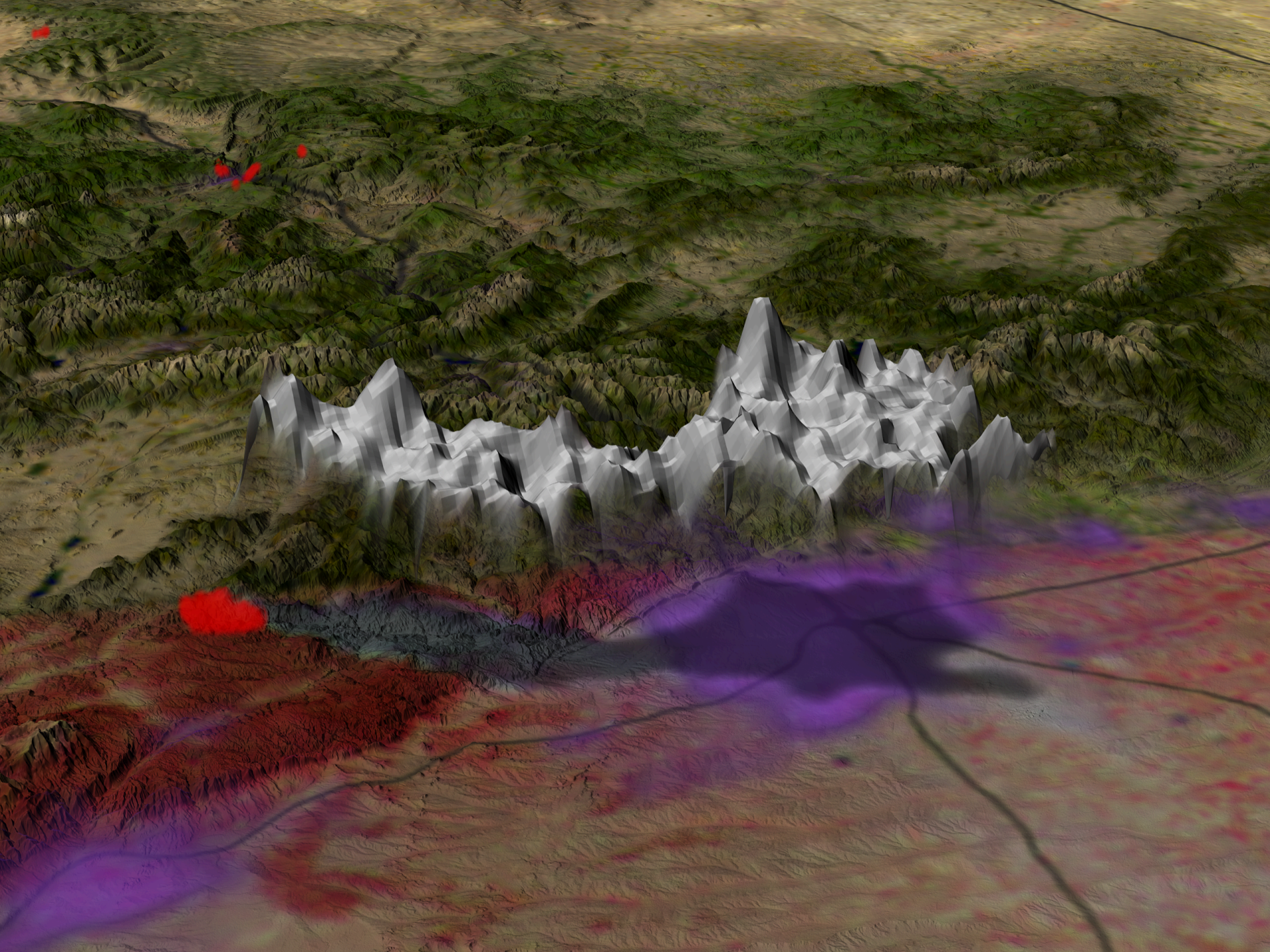
- ❑ Provides snapshots of active burning fires and burned areas
- ❑ The Active Fire product delivers actively burning locations on a daily basis at 1km resolution (additional 8 day and monthly products)
- ❑ Represents the center of a 1km pixel that is flagged by the algorithm as containing one or more fires within the pixel
- ❑ The Thermal Anomalies product detects other thermal anomalies such as volcanic signatures



**Global Fire Map
(August 9 – August
18, 2015)**

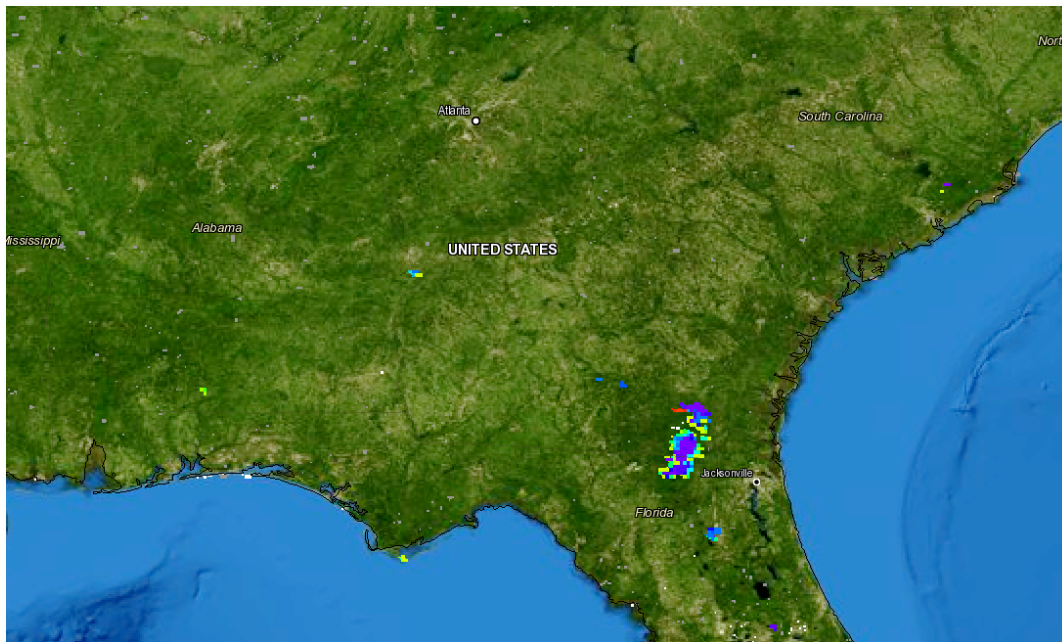
Color ranges from red where the fire count is low to yellow where the number of fires is large.

<https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms/mcd14dl>



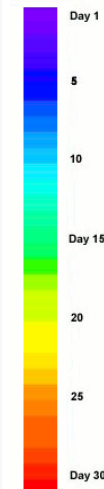
MODIS Land Products: Burned Area (MCD45A1)

- ❑ The combined Terra & Aqua MODIS Burned Area Product is a monthly gridded 500m product
- ❑ MODIS detects the approximate date of burning at 500m resolution
- ❑ Maps include the spatial extent of recent fires
- ❑ For more information: <http://modis-fire.umd.edu>



This image shows the extent of the Bugaboo Scrub fire that occurred from April to June 2007 in Georgia and Florida

The colors represent the approximate day of the burning between April and May 2007



NASA: Fire Information for Resource Management System (FIRMS)

- ❑ Delivers global MODIS hotspots/fire locations and MODIS burned area images
- ❑ Provides historical data (older than 7 days) using the Archive Download Tool
- ❑ Available in various formats:
 - ❑ Email alerts
 - ❑ Download in GIS-friendly format
 - ❑ Visualize in **Web Fire Mapper** or **Worldview**

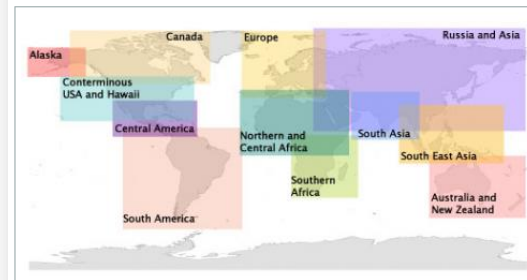
FIRMS: Downloading Active Fire Data

- ❑ Download as Shapefile, KML, WMS, TXT
- ❑ Available for the last 24,48 hours and 7 days

Shapefile

Download shapefiles of MODIS active fire data for the last 24 and 48 hours, and 7 days. For more information, please see the [SHP README \(PDF\)](#).

For data older than 7 days, use the [Archive Download Tool](#).



World	24h	48h	7d	Archive
Alaska	24h	48h	7d	Archive
Australia and New Zealand	24h	48h	7d	Archive
Canada	24h	48h	7d	Archive
Central America	24h	48h	7d	Archive
Europe	24h	48h	7d	Archive
North and Central Africa	24h	48h	7d	Archive
Russia and Asia	24h	48h	7d	Archive
South America	24h	48h	7d	Archive

<https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms/active-fire-data>

FIRMS: Downloading Archived MODIS Fire Data

- ❑ For data older than 7 days use the **Archive Download Tool**
- ❑ Need to submit a request
- ❑ Information needed: location and date range
- ❑ Output: Shapefile or CSV
- ❑ Data not available prior to 2000

Fire Information for Resource Management System

FIRMS MODIS Fire Archive Download

☒ Map ☐ Protected Area



☒ Navigate Map ☐ Draw Polygon ([Clear Polygon\[s\]](#))

Create Rectangle using Coordinates:

Bottom-Left X, Y:

Top-Right X, Y:

Options

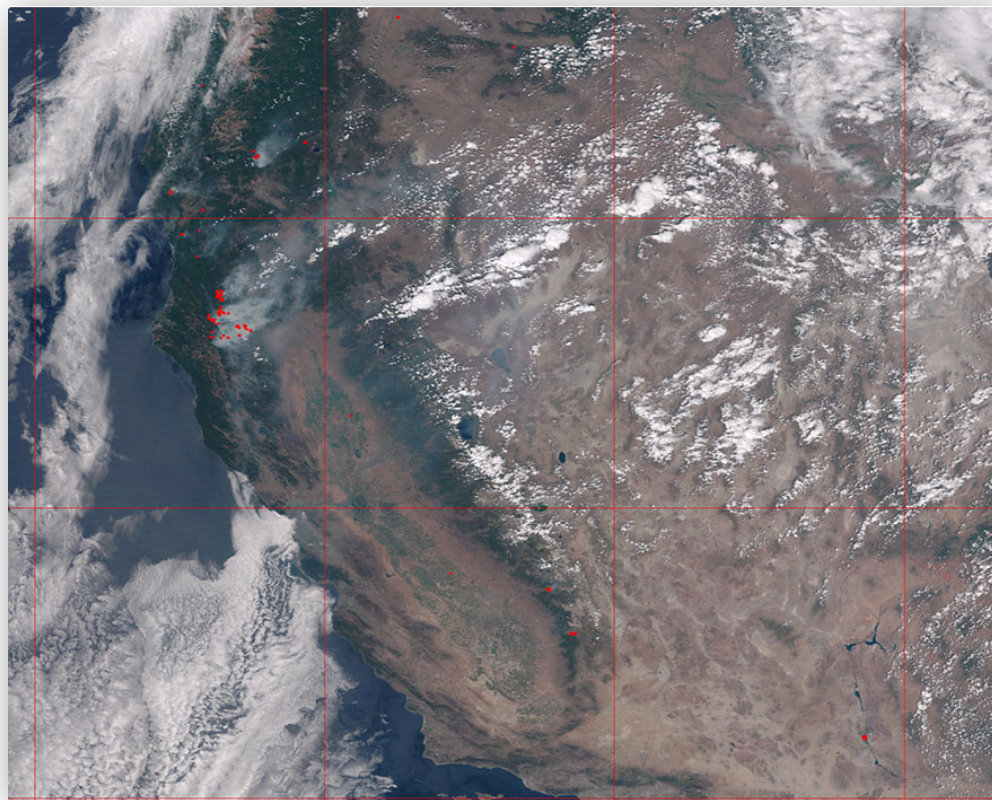
From what date?

To what date?

<https://firms.modaps.eosdis.nasa.gov/download/>

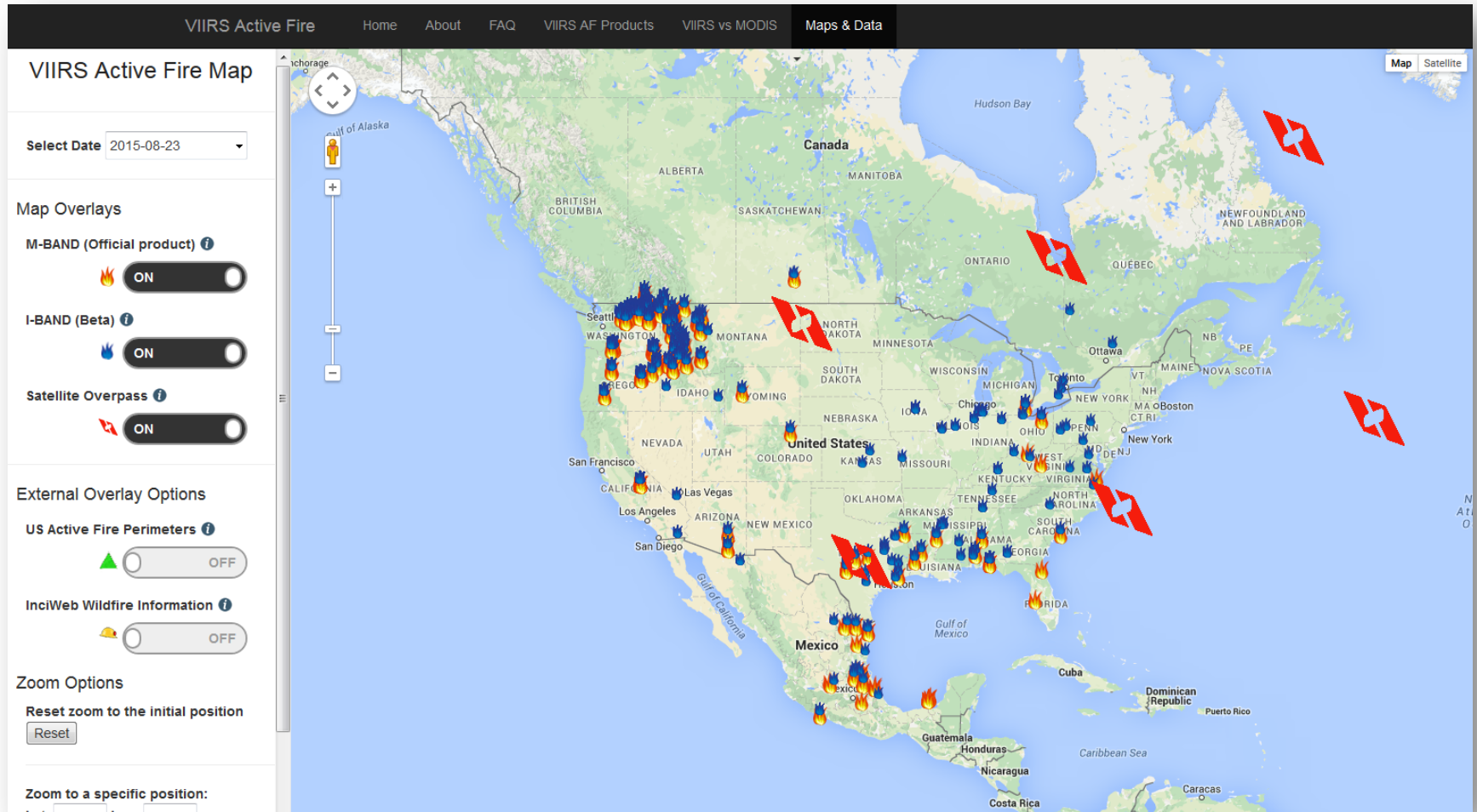
VIIRS Active Fire Product

- ❑ The Visible Infrared Imaging Radiometer Suite (VIIRS) sensor was launched on October 28, 2011.
- ❑ The VIIRS active fire product was released to the public on October 22, 2012
- ❑ Spatial resolution: 750m (M-band)
- ❑ Data are still preliminary (i.e. Beta) and continue to undergo evaluation and calibration
- ❑ Current research: develop active fire product at 350 meter (I-band)



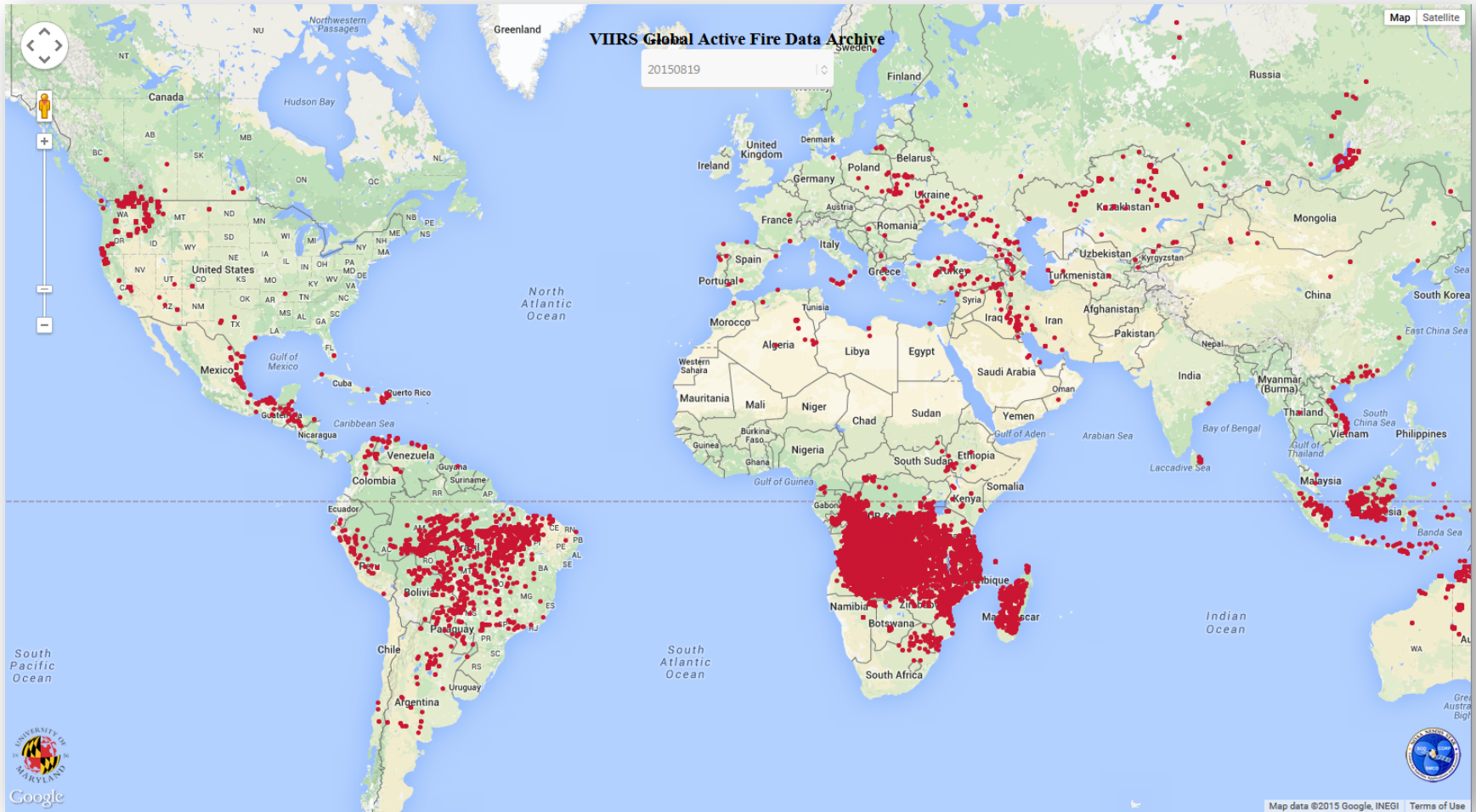
Northern California fires 2015

VIIRS Active Fire Map (CONUS)



http://viirsfire.geog.umd.edu/map/map_v2.php

VIIRS Active Fire Map (Global)



<http://viirsfire.geog.umd.edu/map/globalClass.php>

US Forest Service Active Fire Mapping Program

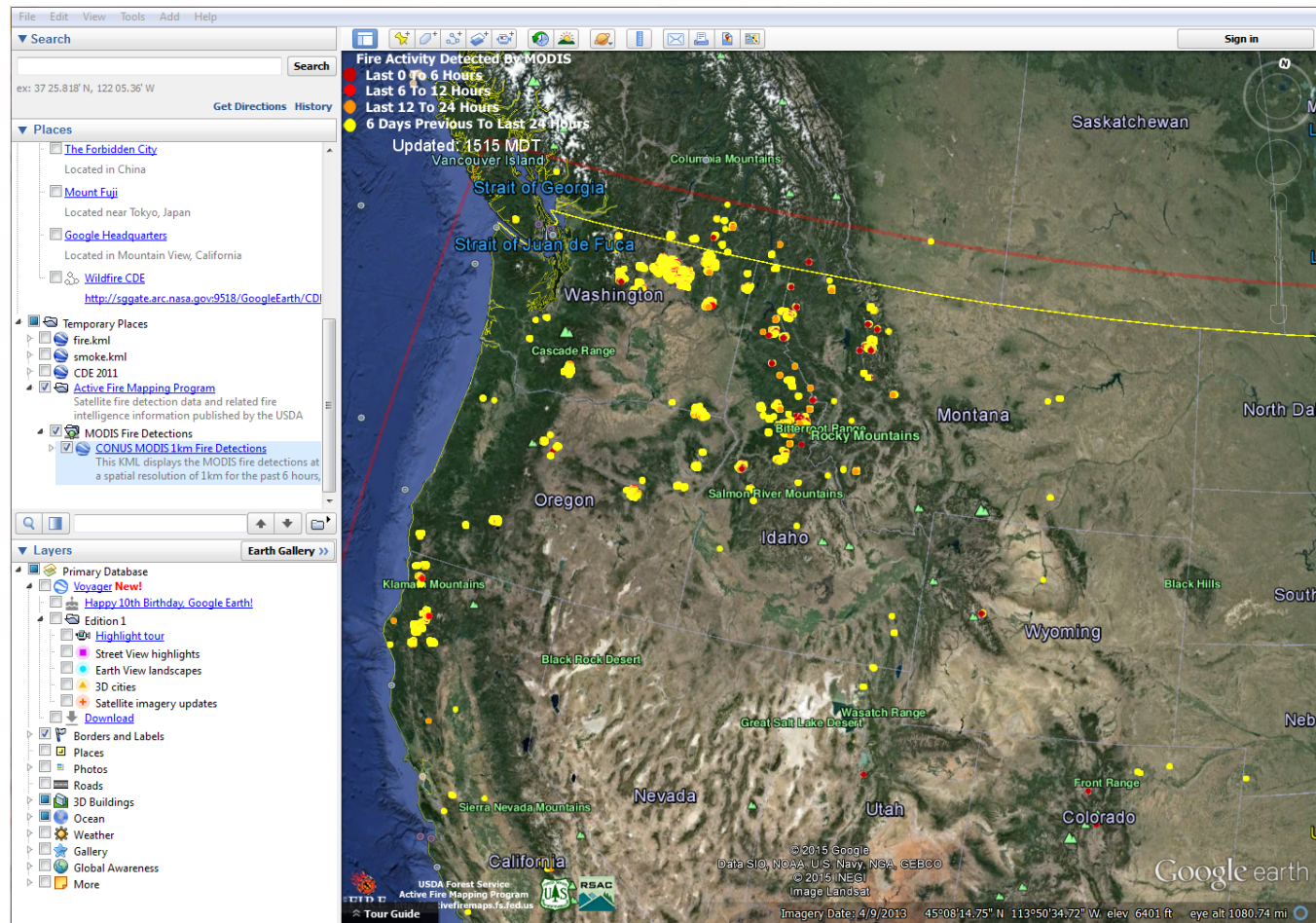
- ❑ Satellite detection and monitoring of wildfire activity in CONUS, Alaska, Hawaii and Canada
- ❑ Leverage NASA and NOAA assets:
 - ❑ GOES, AVHRR, MODIS, VIIRS
- ❑ Provision of comprehensive, NRT data are essential
- ❑ Facilitates decision support for strategic planning and response for U.S. and Canadian fire agencies

<http://activefiremaps.fs.fed.us/index.php>



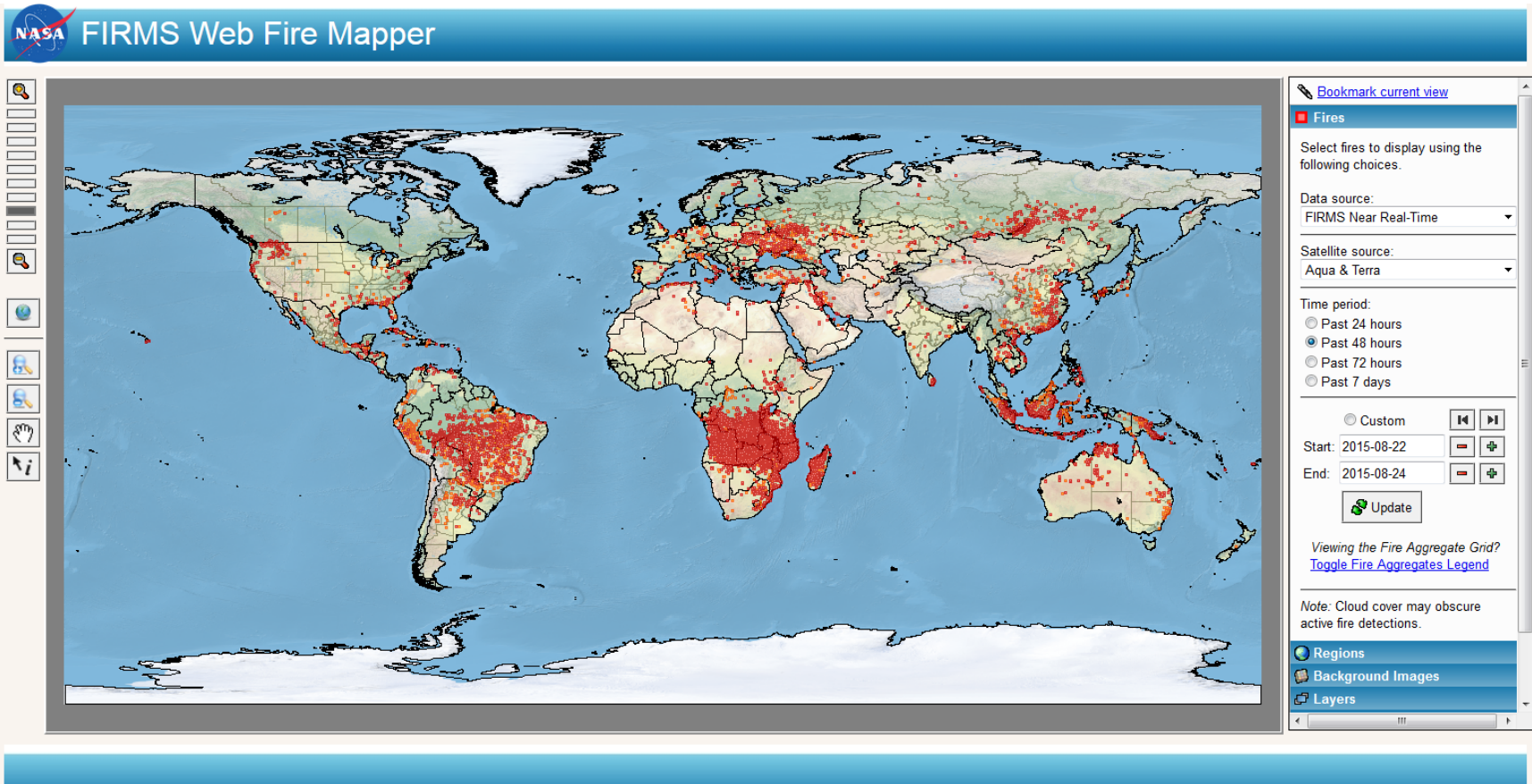
US Forest Service Active Fire Mapping Program

Visualizing using Google Earth



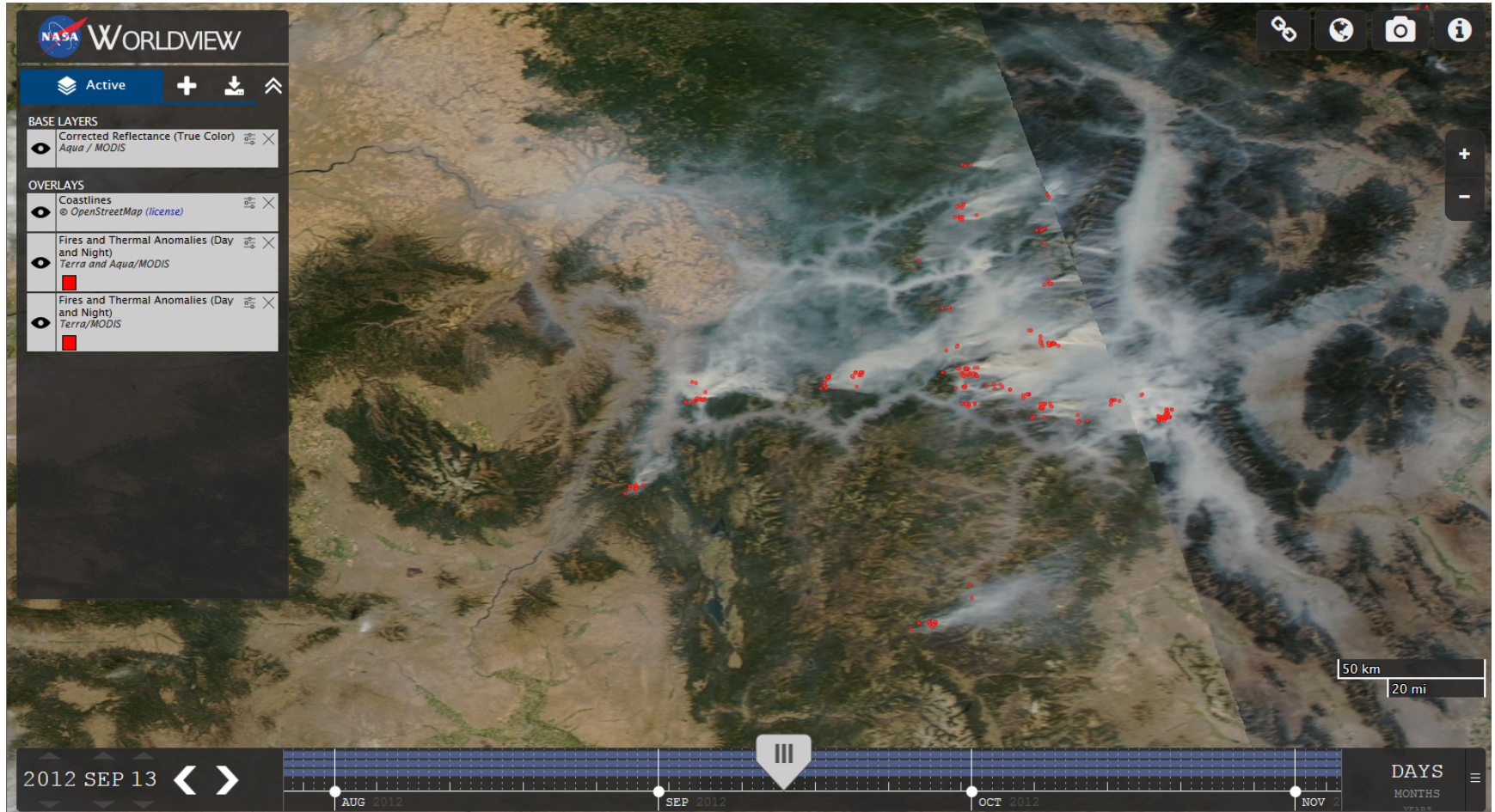
<http://activefiremaps.fs.fed.us/googleearth.php>

FIRMS Web Fire Mapper (Demo)



<https://firms.modaps.eosdis.nasa.gov/firemap/>

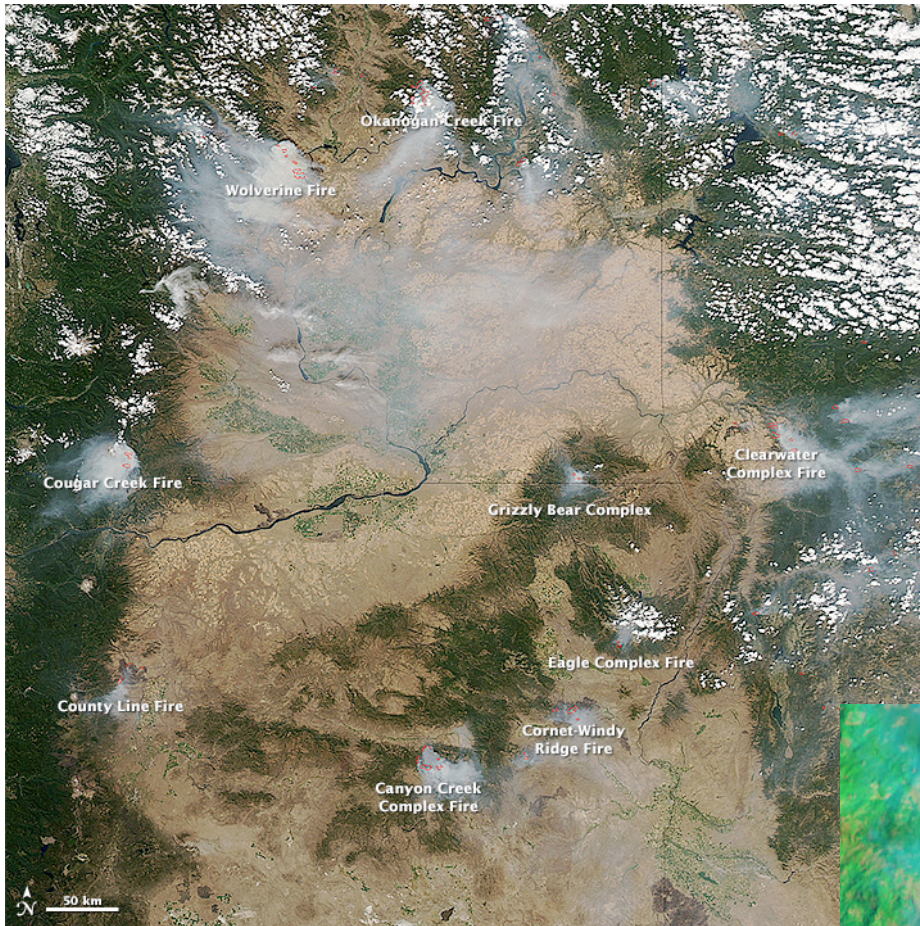
NASA Worldview (Demo)



<https://earthdata.nasa.gov/labs/worldview/>

THANK YOU!

QUESTIONS?



Multiple fires burning in Northwestern US: Image from MODIS, acquired August 17th, 2015

Mad River Complex Fires in California's Six Rivers National Forest: Image from EO-1, acquired August 22, 2015

